

CHILEAN CRIBRIMORPHA (BRYOZOA CHEILOSTOMATA)*

Cribrimorfos chilenos (Bryozoa cheilostomata)

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ABSTRACT

A structural and systematic study on the Bryozoa Cheilostomata Cribrimorpha inhabiting Chilean waters is presented. Thus, the following species have been analyzed: *Cribralaria labiodentata* Moyano, 1983 and *Cribrilaria paschalis* Moyano, 1973 from Easter island, *Cribrilaria innominata* (Couch, 1844) from Juan Fernández Archipelago, *Bellulopora bellula* (Osburn, 1950) from Central Chile, *Jolietina latimarginata* (Busk, 1884) and *Parafigularia magellanica* (Calvet, 1904) from the southernmost Chilean archipelagos, and the antarctic species *Cribrilina projecta* Waters, 1904, *Membraniporella antarctica* Kluge, 1914 and *Figularia spatulata* (Calvet, 1909).

The new genus *Parafigularia* is proposed to include *Membraniporella magellanica* Calvet, 1904, on account of its trilocular zoarial modules being composed of an autozoid, an avicularium and a distalmost kenozoid.

It is proved that the costate frontal secondary wall of *Bellulopora bellula* is made up of "umbonuloid costae" issuing from marginal dietellae other than those communicating neighbouring zooids.

SEM photographs and drawings are provided to show the different zooidal structures.

Keywords: Bryozoa Cheilostomata. Systematics. South - Eastern Pacific.

RESUMEN

Se presenta un estudio sistemático y estructural de los Bryozoa Cheilostomata Cribrimorpha que se encuentran en aguas chilenas. Estos incluyen, las siguientes especies: *Cribralaria labiodentata* Moyano, 1983 y *Cribrilaria paschalis* Moyano, 1973 de la Isla de Pascua; *Cribrilaria innominata* (Couch, 1844) del Archipiélago de Juan Fernández; *Bellulopora bellula* (Osburn, 1950) de Chile Central; *Jolietina latimarginata* (Busk, 1884) y *Parafigularia magellanica* (Calvet, 1904) de los Archipiélagos australes chilenos y las tres especies antárticas *Cribrilina projecta* Waters, 1904, *Figularia spatulata* (Calvet, 1909) y *Membraniporella antarctica* Kluge, 1914.

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Se propone el nuevo género *Parafigularia* para acomodar a *Membraniporella magellanica* Calvet, 1904, por presentar módulos zoariales triloculares compuestos por un autozooide, una avicularia y un quenzooide distal.

Se prueba que la pared frontal secundaria de *Bellulopora bellula* se compone de costillas umbonuloides que se originan de cavidades dietelares distintas de las que comunican zooideos vecinos.

Para demostrar las diferentes estructuras zoidales se incluyen dibujos y fotografías al microscopio electrónico de barrido.

INTRODUCTION

Among the different structures protecting the membranous frontal wall of the Anascan Cheilostomata, the pericyst proves to be one of the most productive structures from an evolutive point of view. It characterizes the families Arachnopusiidae, Hiantiporidae, Exechonellidae, Cribrilinidae (Bassler, 1953, Harmer, 1957) and the many Cretaceous Cribrimorph families described by Lang (1921). In the first three families, as in some genera like *Trilaminopora* (Moyano, 1970) the pericyst originates from irregular spines or processes coming inward from the extraterminal calcareous wall. These extensions fuse and leave an irregular set of lacunae which vary from many (*Arachnopusia*, *Exechonella*) to one (*Trilaminopora*). Apart from these families, pericyst-like structures form in some genera or species in various families, viz. Callaporidae, Scrupocellariidae, Bicellariellidae, where this protective shield results from enlarged spines or plates (Harmelin, 1975; Larwood, 1969; Harmer, 1926).

The Recent Cribrilinidae and the Cretaceous related families display a pericyst made up of hollow parallel radiating ribs which can fuse by their ends or lateral margins thus being separated by slits or pore rows. The families bearing this sort of pericyst constitute the Cribrimorpha proper (Lang, 1916, 1921; Harmer, 1926; Osburn, 1950; Cuffey, 1973). Some Ascophora families seem to have derived from cribrimorph ancestors such as Catenicellidae, in which it is possible to see several lineages starting on genera with pericystal frontal secondary walls (Banta & Wass, 1979). On the other hand, the existence of cribrimorph ancestors in some exochellid genera like *Romancheina* – whose post-ancestral zooids have an umbonuloid frontal wall – would probably evidence an origin from cribrimorph ancestors (Moyano, 1968).

Cretaceous Cribrimorpha have been principally studied by Lang (1921) and Larwood (1962) who have produced large monographic memoirs. The Tertiary and Recent ones appear in many faunal studies from different parts of the world (MacGillivray, 1895; Jullien, 1886; Harmer, 1926; Osburn, 1950; Brown, 1952). Among the more recent papers, special mention deserves the one on the Mediterranean *Cribrilaria* (Harmelin, 1970) and those devoted to the Cribrimorpha from the Eastern Atlantic (Harmelin, 1978) and to the Western Africa forms. (Cook, 1967).

In the Southern Hemisphere there seems that no large monographic studies on the Cribrimorpha have been made; although many genera and species have been dealt with in works devoted to Recent and

Tertiary faunas from Australia, New Zealand and South America (MacGillivray, 1885; Waters, 1905; Calvet, 1904a, 1904b, 1909; Brown, 1952; Powell, 1967).

The Cribrimorpha from South America and Antarctica are comparatively poorly known; six species have been recorded in the Brazilian coast (Barbosa, 1964); four in the Galapagos islands (Osburn, 1950); one in Juan Fernández islands and three along the Chilean coast (Moyano, 1983); and only three south of the Antarctic Convergence (Rogick, 1965). Unlike the Antarctic, the small and remote Easter island has three cribrimorphs out of 18 known bryozoan species (Moyano, 1973, 1983).

The aim of the present contribution is to improve the scarce knowledge on the small but peculiar cribrimorph fauna from Chile. Thus, this work will deal with the zooidal structure, geographical distribution and systematic position of the species studied.

MATERIALS AND METHODS

a. The studied samples were collected as indicated hereinafter:

Easter Island (27°07'S; 109°22'W), 1934, 76 m depth; collector: Ottmar Wilhelm G. Species: *Cribrilaria innominata* and *Cribrilaria labiodentata*; 1972, intertidal; collector: H. I. Moyano. Species: *Cribrilaria paschalis*.

Juan Fernández Archipelago: (33°38'S; 78°58'W), 1967, 3–5 m depth; collector: G. Sanhueza B. Species: *Cribrilaria innominata*.

Central Chile (33°06'S; 71°49'W), 1964, 137 m depth; collector: H. I. Moyano & E. Alarcón. Species: *Bellulopora bellula*.

Magellanic Region: (Magellanic Archipelagos 50°S; 55°S), Centolla Expedition, 1961–1962. Bahía Inútil Magellan Strait ca. 30 m depth; collector: V. A. Gallardo. Species: *Jolietina latimarginata* and *Parafigularia magellanica*.

Antarctic Region: Low island (68°25.5'S; 62°09.5'W), 1969; 60 m depth; collector: J. Castillo. Species: *Figularia spatulata*; Robert island (62°23'S; 59°37'W), 1965, 20 m depth; collector: H. I. Moyano. Species: *F. spatulata*; Doumer island (64°52'S; 63°36'W), 1973, 67 m depth; collector: M. A. Retamal. Species: *Membraniporella antarctica*. Ross Sea Area, (75°00'S; 169°28'E) 1967, 124–329 m depth, and (76°02.15'S; 179°–57'W), 1972, 347–358 m depth. Species: *Cribrilina projecta*; one colony from each of these areas was sent to the author by J. Winston from the Smithsonian Sorting Center, Washington. In addition, a loan specimen of *C. projecta* labeled '450' from the Discovery Collections was studied; this specimen, sent from the British Museum (N. H.) by P. L. Cook has, unfortunately, no collecting data.

b. For each species, a brief diagnosis and a table with measurements are given. This table includes the following measurements in mm based on twenty different zooids or zooidal structures.

Z.l. = zoecial length
Z.w. = zoecial width
Apl. = zoecial orifice length
Ap.w. = zoecial orifice width
Av.l. = avicularium length
Av.w. = avicularium width
O.l. = ovicell length
O.w. = ovicell width
Av.m.l. = avicularian mandibule length
Av.m.w. = avicularian mandibule width
F.r.n. = pericyst rib number.

Following each specific diagnosis, the measurements will appear this way: z.l. = 0.756 0.923 0.805 0.907 showing minimum, maximum, average value, and the standard deviation respectively.

c. Drawings were made with the aid of a camera lucida from dry and/or wet material. Photographs were taken with an Auto Scan ETEC Electromicroscope (SEM). Samples were metalized with a gold bath of 300 Å thick. Photographic film is 21 Din. Samples for SEM photographs were previously boiled in a concentrated NaClO solution.

d. Terminology applied to the hard parts follows Lang, 1921, Osburn, 1950 and Banta 1970. The interpretation of soft and hard parts follows Banta and Wass, 1979.

RESULTS

A. SYSTEMATICS

In this section all the species and the new genus will be summarily described.

Ballulopora bellula (Osburn, 1950)

Figs. 1, 2, 18, 19, 20.

Colletosia bellula Osburn, 1950: 188; pl. 29, fig. 1.

Bellulopora bellula (Osburn), Lagaij, 1963: 184; pl. 4, fig. 2. Moyano & Melgarejo, 1977: 172; figs. 9–11.

DIAGNOSIS:

Zoarium encrusting, unilaminar, pluriserial, white, glistening. Zooids large, separated by deep furrows. Frontal secondary wall having 11–16 ribs excluding the apertural bar; these ribs being separated by many disto-proximal elongated pores. Primary aperture a clithridiate orifice closed by an operculum of the same form and size; secondary aperture at the end of a horse-shoe-shaped distally elevated peristome. Two tiny

disto-lateral avicularia forming the distal part of the peristome, frequently wanting or replaced by blunt processes. Hyperstomial ovicell (calcified entoecium) being actually immersed into a distal kenozooid (this being the "ectoecium") made up of 10-12 ribs exactly in the same way as the frontal wall. With a large number of basal dietellae interlocking with the ones that originate the frontal ribs of both zooids and kenozooidal ovicells.

Measurements in mm.

Z.l.	=	0.700	—	1.000	—	0.855	—	0.106
Z.w.	=	0.500	—	0.750	—	0.583	—	0.076
Ap.l.	=	0.163	—	0.188	—	0.174	—	0.007
Ap.w.	=	0.138	—	0.175	—	0.155	—	0.009
O.l.	=	0.300	—	0.500	—	0.411	—	0.067
O.w.	=	0.375	—	0.500	—	0.408	—	0.039
Fr.n.	=	13		18		16		1.30
Or.n.	=	10		12		10.45		0.59

DISTRIBUTION

Gulf of California, 14-40 fms; Galapagos islands 50-60 fms; Pleistocene of New Port Harbor Mesa, Southern California (Osburn, 1950: 189); Gulf of Mexico (Lagaaij 1963); Central Chile (Moyano & Melgarejo (1977).

Cribralaria labiodentata Moyano, 1983.

Figs. 3, 21, 22, 23.

Cribralaria labiodentata Moyano, 1983: 7, Fig. 5.

DIAGNOSIS:

Zoarium encrusting, unilaminar, white, glistening. Zooids large, flat, separated by low furrows; frontal secondary wall having 11-18 ribs including the apertural pair, separated by two rows of pores; apertural rib pair stout, fused in the middle and serrated in their distal border causing the proximal side of the aperture being dentate; one pair of distal lateral oral sines fused medially forming the distal apertural border. Avicularium interzoecial, asymmetrical, with an irregular quadrate chamber and a long, asymmetrical curved and produced rostrum; avicularian mandibule long pointed and asymmetrical. Ovicell endozoecial, hemispherical, shallow immersed into the avicularian chamber. Interzooidal communication pores numerous, round, simple and forming a line along the lateral and distal walls.

Measurements in mm.

Z.l.	=	0.625	1.000	0.759	0.099
Z.w.	=	0.300	0.475	0.371	0.048
Ap.l.	=	0.100	0.125	0.113	0.011
Ap.w.	=	0.125	0.175	0.146	0.012
Av.l.	=	0.150	0.250	0.186	0.023
Av.w.	=	0.125	0.200	0.156	0.027
Av.m.l.	=	0.250	0.450	0.351	0.045
Av.m.w.	=	0.088	0.125	0.106	0.012
F.r.n.	=	11	18	13.05	1.761

DISTRIBUTION:

Known only from type locality, Easter Island. 70 m. depth, on coral blades (Moyano, 1983).

Cribrilaria innominata (Couch, 1844)

Figs. 4, 24.

Lepralia innominata Couch, 1844: 114; pl. 22, fig. 4.

Cribrilaria innominata (Couch), Harmelin, 1970: 84; figs. 1d, e, f, 2; pl. I, 4-6; 1978: 179; pl. 2, 1, 2.

DIAGNOSIS:

Zoarium encrusting, unilaminar, white. Zooids small, ventricose, separated by deep furrows; frontal secondary wall having 12-17 ribs in unfertile zoecia and 11-16 infertile ones; between every two rib bases, there is a large marinal pore which is followed by four to five smaller ones towards the center of the pericyst; apertural ribe pair bifurcated leaving a triangular suboral pore. Zooidal aperture semicircular encircled by five spines in unfertile zooids and only four in fertile ones. Avicularium interzoecial, large, reaching one half or more of the zoecial length, with a long and acute mandibule. Ovicell hyperstomial, globose, imperforate. Communication pores in serially disposed dietellae around the zoecial base.

Measurements in mm.

Z.l. unfertile zooid	=	0.313	0.500	0.421	0.047
Z.w. " "	=	0.225	0.375	0.277	0.033
Z.l. fertile zooid	=	0.313	0.475	0.394	0.041
Z.w. " "	=	0.213	0.350	0.264	0.042
Ap.l.	=	0.050	0.063	0.053	0.004
Ap.w.	=	0.069	0.085	0.077	0.004
Av.l.	=	0.188	0.375	0.256	0.047
Av.w.	=	0.125	0.250	0.184	0.037
A.m.v.	=	0.125	0.250	0.186	0.045
Av.m.w.	=	0.031	0.088	0.057	0.016
F.r.n. unfertile zooid	=	12	17	14.2	1.29
F.r.n. fertile zooid	=	11	16	13.55	1.39

DISTRIBUTION:

Species considered to be cosmopolite (Harmelin, 1978). In Chilean waters, it has been found in Easter island at 76 m depth and in Juan Fernández Archipelago at 3-5 m depth.

Cribrilaria paschalis Moyano, 1973.

Figs. 5, 6, 25, 26.

Cribrilaria paschalis Moyano, 1973: 8; pl. I, 5.

DIAGNOSIS:

Zoarium encrusting, unilaminar, white. Zooids small, ovate convex, separated by deep furrows; frontal wall composed of 11-17 ribs separated by 2-3 intercostal round and large pores; suboral pore triangular, lying vertically and therefore perpendicular to the apertural plane. Semi-circular zoecial aperture encircled by seven spines in unfertile zooids and having only four in fertile ones. Interzoecial avicularia small, variable, irregularly distributed, its mandibule triangular, long. Imperforated hyperstomial ovicell closed by the operculum. Communication pores in serially disposed dietellae around the zoecial base.

Measurements in mm.

Z.l. unfertile zooid	=	0.275	0.475	0.349	0.050
Z.w. " "	=	0.175	0.250	0.223	0.029
Z.l. fertile zooid	=	0.250	0.375	0.297	0.032
Z.w. " "	=	0.175	0.250	0.213	0.027
Ap.l.	=	0.038	0.075	0.054	0.011
Ap.w.	=	0.050	0.075	0.067	0.007
Av.l.	=	0.113	0.188	0.158	0.021
Av.w.	=	0.050	0.125	0.091	0.025
Av.m.l.	=	0.050	0.113	0.081	0.014
Av.m.w.	=	0.025	0.050	0.032	0.006
O.l.	=	0.100	0.138	0.124	0.009
O.w.	=	0.125	0.150	0.132	0.011
F.r.n. unfertile zooid					
F.r.n. fertile zooid					

DISTRIBUTION:

Known only from type locality, Easter island, intertidal zone, on algae (Moyano, 1973).

Cribrilina projecta Waters, 1904.

Figs. 11, 12, 13, 27, 28, 29, 32.

Cribrilina projecta Waters, 1904: 41; pl. II, figs. 14a-d.*Cribrilina projecta* Waters, Thornely, 1924: 10.*DIAGNOSIS:*

Zoarium encrusting, unilaminar white to translucent. Zooids large, somewhat lageniform, not much longer than wide, separated by deep furrows obscured later by calcification; frontal wall a pericyst occupying almost all the frontal visible surface; pericyst composed of 16-19 narrow ribs in zooids near the ancestrula attaining from 22 to 30 in older zooids far from the ancestrula; ribs separated by 6-7 round pores. Apertural bar thick and stout apparently given vertical offshoots in older zooids; Oral area produced into a peristome; secondary aperture transversely oval, its margin irregularly dentate, teeth being the tip of the finer branches resulting from the repeated division of the oral spines. Peristome principally formed by a pair of disto-lateral strongly stout spines that divide many times and encircling the oral area and fusing between resulting branches. Primary aperture without special structures. Zooidal operculum not much differentiated from the membranous frontal wall. Avicularia small, triangular, acute, pointing proximally; they originate probably from nearby dietellae in triangular spaces where three zooids meet. Ovicell unknown. Communication pores in large dietellae around the lateral walls.

Measurements in mm.

Z.l.	=	0.900	1.125	1.028	0.067
Z.w.	=	0.575	0.875	0.720	0.080
Ap.l.	=	0.150	0.200	0.171	0.014
Ap.w.	=	0.225	0.275	0.256	0.016
Av.l.	= (N= 6)	0.188	0.225	0.200	0.013
Av.w.	= (N= 6)	0.075	0.125	0.099	0.016
F.r.n. Near ancestrula	(N= 4)	16	19	17.25	1.09
F.r.n. far from ancestrula	(N=20)	22	30	23.70	1.64

DISTRIBUTION:

Antarctic seas. 70°23'S; 82°47'W, 480 m. (Waters, 1904). Commonwealth Bay, 110 fms. (Thornely, 1924). Ross Sea area: 75°00'S; 169°28'E, 324-329 m, 76°02,15'S; 179°57'W, 347-358 m, after the samples sent to the author from the Smithsonian Institution Sorting Center and collected by the R/V Eltanin in 1967 and 1972 respectively.

Figularia spatulata (Calvet, 1909)

Figs. 10, 36, 37.

Cribrilina spatulata Calvet, 1909: 9; pl. 2, figs. 1-3.*Cribrilina spatulata* Calvet, Thornely, 1924: 10.*Figularia spatulata* (Calvet), Livingstone, 1928: 47; pl. 2, fig. 6, Vigeland, 1952: 8.**DIAGNOSIS:**

Zoarium encrusting, unilaminar, pluriserial, white-yellowish. Zooids large, elongated separated by low furrows; frontal wall a fairly developed gymnocyst made up of 11-17 flattened ribs that fuse in the middle and laterally being separated by long slits; gymnocyst well developed but variable in its proximal extension; apertural bar ribs wider and stouter delimiting a central v-shaped small sinus in the proximal side of the aperture. Zoecial aperture almost identical in fertile and unfertile zooids, with two small latero-proximal denticles for the articulation of the operculum; four cylindrical lateral oral spines in unfertile zooids and two spatulated ones in fertile zooids. Avicularia unknown, apparently wanting. Ovicell hyperstomial large, elongated round to mitriform, with two teardrop-shaped uncalcified areas on ectoecium. Two uniporous septulae on each lateral wall and another on the distal wall.

Measurements in mm.

Z.l. unfertile zooid	0.575	0.925	0.786	0.103
Z.w. " "	0.300	0.425	0.354	0.035
Ap.l. " "	0.125	0.175	0.158	0.013
Ap.w. " "	0.150	0.200	0.174	0.011
Z.l. fertile zooid	0.700	0.100	0.879	0.104
Z.w. " "	0.250	0.375	0.335	0.034
Ap.l. " "	0.150	0.200	0.172	0.015
Ap.w. " "	0.150	0.200	0.186	0.015
Ov.l.	0.300	0.425	0.368	0.026
Ov.w.	0.250	0.350	0.306	0.021
F.r.n. unfertile zooid	14	20	16.70	1.65
F.r.n. fertile zooid	14	24	18.25	3.05

DISTRIBUTION:

Antarctic endemic species. Kaiser Wilhelm Sector and Victoria and Adeliae Lands (Thornely, 1924; Livingstone, 1928); Bellingshausen Sea Sector (Calvet, 1909; Vigeland, 1952); Heard and MacDonald islands (d'Hondt, 1979); South Shetlands (Moyano, 1979, 30-90 m depth).

Jolietina latimarginata (Busk, 1884)

Figs. 16, 17, 33, 34.

Cribrilina latimarginata Busk, 1884: 131; pl. 22, figs. 10. Calvet, 1904b: 18; Waters, 1905: 236.

Jolietina latimarginata (Busk), Canu & Bassler, 1929: 244, 101 a, b. Moyano, 1974: 10.

DIAGNOSIS:

Zoarium encrusting, unilaminar, multiserial yellowish. Zooids wide, nearly flat, initially separated by deep furrows that later disappear becoming filled by calcareous outgrowings; pericyst made up of 9–14 ribs, which are clearly defined where they originate but becoming confused in the pericyst centre; pericystal orifices round to reniform, not clearly disposed as intercostal rows. Vibracularia interzoecial following each autozooid; its chamber round to ovate with an oval frontal aperture having a distal stout condile for the articulation of the vibracularian seta. Zoecial aperture semicircular, narrow, much wider than long; no oral spines observed. Ovicell seemingly endozoecial (C. & B., 1929) not present in the studied samples. With large dietellae in lateral walls.

Measurements in mm.

Z.l.	=	0.350	0.500	0.443	0.045
Z.w.	=	0.225	0.375	0.281	0.031
Ap.l.	=	0.050	0.088	0.072	0.009
Ap.w.	=	0.125	0.150	0.148	0.006
Vibraculum l.	=	0.125	0.250	0.180	0.036
Vibraculum w.	=	0.125	0.250	0.194	0.032
Vibracularin seta l.	=	0.575	1.375	0.919	0.228
F.r.n.	=	9	14	12.75	1.41

DISTRIBUTION:

South Atlantic Ocean, 37°17'S; 53°52'W, 600 fms. (Busk, 1884); Cabo Blanco, Southern Argentinian coast (Calvet, 1904b); North to Falkland islands, 135 m (Waters, 1905); South Eastern Pacific Ocean, 50°36'S; 75°42'W, 70 m (Moyano, 1974).

Membraniporella antarctica Kluge, 1914.

Figs. 14, 15, 30, 31, 35.

Membraniporella antarctica Kluge, 1914: 677; pl. 33, fig. 7.**DIAGNOSIS:**

Zoarium encrusting, unilaminar, multiserial, white-pink. Zooids slightly convex, separated by moderate furrows; gymnocyst somewhat developed laterally and proximally; cryptocyst made up of 13-21 distally bifurcated ribs that fuse only among the central part of the pericyst; each rib bifurcates leaving among branches an elongated hole; on injured zoecia, a second row of ribs develops under the original one, so it is possible to find zooids with a double roof of ribs over the frontal membrane. Zoecial aperture bell-shaped encircled by four and two oral spines respectively in unfertile and fertile zooids; these spines may bifurcate as the pericystal ones. Ovicell hyperstomial, the ectoecium leaving a triangular space in the fronto-anterior part of the ovicell exposing the entoecium. Avicularia seemingly wanting. Communication pores two simple septulae on each lateral wall and another in the distal wall.

Measurements in mm.

Z.l. infertile zooid	0.625	1.125	0.804	0.108
Z.w. " "	0.325	0.500	0.416	0.045
Z.l. fertile zooid	0.825	0.125	0.949	0.095
Z.w. " "	0.300	0.500	0.371	0.062
Ap.l. unfertile zooid	0.125	0.175	0.158	0.015
Ap.w. " "	0.125	0.175	0.153	0.012
Ov.l.	0.350	0.500	0.424	0.038
Ov.w. " "	0.300	0.450	0.361	0.037
F.r.n.	13	21	16.35	1.82

DISTRIBUTION:

Antarctic endemic species. Kaiser Wilhelm Sector 350-385 m (Kluge, 1914); Heard and MacDonald islands (d'Hondt, 1979); South Shetlands, 50 m (Moyano, 1978).

Parafigularia gen. n.**DIAGNOSIS:**

Cheilostomata having rhomboidal morpho-functional trilocular modules composed of an autozooid plus a dependent distal avicularium and a triangular distalmost kenozooid. Frontal wall made up of a large gymnocyst and a reduced costate pericyst. Ovicell hyperstomial conneted with avicularian chamber. Communication pores not including dietellae.

Type-species: *Membraniporella magellanica* Calvet. 1904.

Parafigularia magellanica (Calvet, 1904).

Figs. 7, 8, 38–44.

Membraniporella magellanica Calvet, 1904a: 53; Calvet, 1904b: 15; pl. 1, figs. 4a–b.*Cribrilina patagonica* Waters, 1905: 236; pl. 28, figs. 6–7.*Figularia patagonica* (Waters), López-Gappa, 1977: 180; pl. 1, figs. 4, 5.**DIAGNOSIS:**

Zoarium encrusting, unilaminar, pluriserial, light-brown to yellowish. Zooids strongly convex separated by deep furrows; frontal wall principally composed of a gymnocyst and of a small pericyst made up of 4–7 short and wide tapering ribs. These ribs meet in the middle forming a low suboral umbo, and separated each other by basal slits. Zoecial aperture dimorphic longer in unfertile zooids and more wide in fertile ones, bellshaped and, therefore, wider proximally. A small transverse elevated avicularium with a triangular mandibule laterally directed, situated distally to each autozooid. Ovicell large being only an elevated convex roof of the distal part of the fertile zooid; its ectoecium being, actually, part of the external wall of the avicularium, and so the entoecium –the ovicell proper– is partially immersed in or wrapped laterally and distally by the avicularian chamber; with a median carena extending to the avicularium; undeveloped avicularia appear as round holes on the distal part of some ovicells. Communication pores as uniporous septulae that may form clusters.

Measurements in mm.

Z.l.	unfertile zooid	0.475	0.750	0.576	0.074
Z.w.	" "	0.300	0.375	0.340	0.018
Ap.l.	" "	0.125	0.175	0.150	0.012
Ap.w.	" "	0.175	0.213	0.186	0.013
Z.l.	fertile zooid	0.550	0.800	0.661	0.074
Z.w.	" "	0.300	0.400	0.361	0.020
Ap.l.	" "	0.150	0.175	0.167	0.009
Ap.w.	" "	0.200	0.250	0.232	0.014
Av.l.		0.150	0.200	0.170	0.018
Av.w.		0.075	0.125	0.108	0.018
Ov.l.		0.225	0.300	0.271	0.023
Ov.w.		0.325	0.400	0.355	0.022
Fr.n.	unfertile zooid	5	7	7.75	0.76
Fr.n.	fertile zooid	4	6	5.10	0.54

DISTRIBUTION:

Magellanic endemic species. Smyth Channel, 8 fms. (Calvet, 1904b); Cape Horn area (Waters, 1905); Beagle Channel (López-Gappa, 1977); Magellanic Archipelagos (Moyano, 1983).

B. GENERAL REMARKS AND DISCUSSION

I. FRONTAL WALLS

The frontal secondary walls of *Cribralaria labiodentata*, *Cribralaria innominata*, *C. paschalis*, *Cribrilina projecta*, *Figularia spatulata*, *Jolietina latimarginata* and *Parafigularia magellanica* are typically made up of hollow costae or ribs issuing from the marginal gymnocyst and, therefore, different from those of *B. bellula* in which they originate from dietellae other than those connecting neighbouring zooids.

Pericystal costae of *J. latimarginata* are clearly set off only at their base because they fuse in an irregular way in the center of the pericyst (Figs. 16, 33, 34). Frontal spines of *C. labiodentata* unlike the former species are clearly distinct although having lateral spines or denticles that fuse, thus producing two rows of pores between each pair of ribs (Fig. 3, 21, 22). Costae of *C. projecta* are numerous, narrow, tapering slightly to the center of the pericyst where they fuse; there are 6–7 round pores every two of these ribs. *C. innominata* and *C. paschalis* have the same type of pericyst but the number of pores separating the ribs diminishes from *C. projecta* to *C. paschalis* and varies in quantities ranging from 6–7, to 4–5, and to 2–4, respectively.

F. spatulata like many species in its genus, develops a gymnocyst encircling the costate frontal shield. In this species, however, it varies from 1/3 of the frontal length to almost nothing. (Figs. 9, 10, 36). The pericyst is made up of relatively flat and not tapering ribs, very close each other, touching and fusing two or three times along their sides leaving slit-like pores. *Parafigularia magellanica*, on the other hand, looks very different from the latter because of the small number of ribs, 4 to 7, which cover a very small area. These costae are small, short and teardrop-shaped fusing by their tips and leaving tiny slits at their bases. No evidence of pelma or pematidia occurs in this or in the former species (Figs. 7, 41).

The extensive pericyst of *M. antarctica* is composed of forked ribs which leave intracostal openings resulting from the branching tips and not homologous with pelma. A striking character seen in several ovicelled and sterile zooids is the presence of a second set of costae under the primary one (Fig. 15). These seem to appear as a response to injuries against the external shield. Perhaps this is an adaptive response to restore the weak pericyst whose spines break off very easily.

The pericyst of *B. bellula* looks and forms in an odd way. A close examination of its surface reveals the presence of a glistening epitheca over the external surface of the "costae". Each of them is actually one radial canal issuing from a dietella lying at the base of the lateral walls. Each of these dietellae alternates with those interconnecting contiguous zooids and seemingly communicate them with the perigastric coelomic cavity. This canal surely represents a coelomic extension whose base is calcified as in an umbonuloid frontal wall (Banta & Wass, 1979), and, therefore,

each of these "costae" is in fact a radial umbonuloid process with an epitheca and a subjacent hypostegal cavity, and separated from the next by a row of slit-like pores. This interpretation of each costa and of the whole pericyst seems to be confirmed when looking at the growing colonial edge; there, the developing zooids exhibit a marginal gymnocystal fold growing and bending inward over the frontal membranous wall (Fig. 2), exactly in the same way as an umbonuloid frontal wall develops (Harmer, 1957; Banta and Wass, 1979). The pores separating the just appearing "costae" on this growing fold do not emerge at its edge proper but towards its periphery. On the other hand, each of these "umbonuloid costae" has a large epitheca covered pore in the same place and situation as areolae in a Gymnocystridean Cheilostomata (Banta, 1973) but lying very near the basal zooidal wall. This pore is actually the upper part of a "costal dietella" and seems to be different from pelma (Lang, 1921) because of its situation and topographic relations.

II. ORAL AREA

The oral frame in Cribrilinidae is limited proximally by either a pair of unmodified or somewhat modified or highly transformed apertural ribs (Lang's apertural bar 1921). In addition, a variable number of oral vertical spines does or does not participate in building a peristome.

In *P. magellanica*, the apertural bar does not differ from the other pericystal spines. Oral spines are wanting and the oral aperture is proportionally wider in ovicelled zooids than in sterile ones. Nor the apertural pair differs in *F. spatulata* from the others composing the frontal shield; oral spines, however, are four cylindrical ones in unfertile zooids and two spatulated on fertile ones. *M. antarctica* shows a similar condition as the former two species in not having a specialized apertural pair, but it differs from the latter in possessing forked oral spines.

The solid but unmodified apertural pair in *J. latimarginata* makes up the straight proximal border of its very wide aperture. This is also straight in both *C. innominata* and *C. paschalis*, but the apertural pair is here bifurcated from its base leaving a triangular to round suboral pore lying on the apertural plane in the first and perpendicular to it in the second (See Harmelin, 1970). The apertural pair of *C. labiodentata* lacks the bifurcation of the *Cribrilariae*, but instead it is wider, stouter and not tapering distally unlike the rest of the pericystal costae; costal spinules grow also on the proximal side of the aperture. In addition, the two distolateral oral spines distally overarch the aperture and fuse leaving and infero-marginal distal pore.

In both *C. projecta* and *B. bellula* oral area includes a peristome. This, in *B. bellula*, encircles a clithridiate primary aperture closed by a very well chitinized operculum of its form and dimension. This peristome results in two pairs of modified outgrowths (Fig. 18, 20); the most proximal is the apertural pair itself and the more distal one can be replaced by two tiny columnar avicularia; these two spinous processes grow up distally and laterally fuse each other forming the peristome which slopes from the distal to the proximal side of the aperture. This situation is more

interpretative than based on a sequencing of each step of the process. A different situation occurs in *C. projecta* where there are no oral avicularia but, instead, ramifying processes originating from the apertural bar and from a pair of latero-distal "spines" (Figs. 29, 32). These ramifying structures grow up and laterally fuse forming a produced peristome; the primary aperture is not closed by an operculum although it communicates widely with the subpericystal cavity; the operculum proper is in direct relation with the membranous frontal wall as in *Arachnopusia* or in the gymnocystidean genera *Romancheina*, *Cellarinella* and *Systemopora* (Moyano, 1968). In the zoarial growing edge it is possible to follow the whole building sequence of the peristome in *C. projecta* (Figs. 12, 28, 32). Difference in operculum construction, hard in *B. bellula* and weak in *C. projecta* is probably related to two different strategies to protect the entrance to the subpericystal cavity (homologous to the "ascus" in a Gymnocystidean Cheilostomata like *Umbonula*) the secondary aperture of *B. bellula* is relatively large and the peristome slightly produced, whereas in *C. projecta* the oblong and disto-laterally compressed secondary aperture crowns a fairly long peristome with dentate free border; thus, the strong operculum in *B. bellula* protects a wide and open aperture, whereas in the second the protection results from the elongation and narrowing of the peristome with less specialization of the operculum.

III. OVICELLS

The ovicells of *Cribrilaria innominata* and of *C. paschalis* are of the hyperstomial type and closed by the operculum. Those of *Figularia spatulata* and *Membraniporella antarctica* are also hyperstomial but with an exposed area of the entoecium. This area is central and triangular in *M. antarctica* and a double bilaterally symmetrical drop-shaped structure in *F. spatulata*. They seem to decrease with age and calcification. The ovicell of *J. latimarginata* has been said to be endozoecial (Bassler, 1953) but the paucity of the studied material does not permit to solve this situation. This is also true of *C. projecta*.

Unlike the species indicated above *Cribrilaria labiodentata* has endozoecial, shallow ovicells immersed in the distal avicularium that follows each zooid which do not bulge over the frontal wall of the avicularian chamber making them overlooked by a casual observer.

Ovicells of *Parafigularia magellanica* and of *Bellulopora bellula* are of the hyperstomial type in a general sense but very special in their structure and spatial relations with neighbouring structures. In *P. magellanica* the ovicell is made up of an entoecial calcified part issuing from the distal and lateral borders of the fertile zooid and of an ectoecium formed by the proximal extension of the avicularian chamber in which the ovicell is partially immersed. It does not possess the uncalcified lateral symmetrical fenestrae of the typical figularian ovicells and it is in addition, crowned by the avicularium thus forming an ovicell complex. In some of these complexes the avicularium fails to develop appearing in its place a circular hole. As both situations can occur in the same zoarium and in very close zoecia it seems to represent different steps in the avicularium

ontogeny. Avicularia as round holes were described by Calvet, 1904, Waters 1905 and recently by López-Gappa; the latter discuss them indicating the relations between *Membraniporella magellanica* Calvet and *Cribrilina patagonica* Waters.

In *B. bellula* the ovicell external wall (=ectocium) has the same structure as the frontal shield, that is it, is composed of the "umbonuloid costae" described above. This fact and the presence inside the ectocium of a calcified globular structure (=the entocium) widely separated from the ectocium leads one to consider the ovicell as being a kenozooid. In addition, between the interior wall of the ectocium and the exterior one of the entocium is a horizontal membrane that seems to be homologous to the frontal zooidal membrane. On the other hand, in a developing ovicell of the colonial growing margin it is possible to see the same pattern of alternating dietellae giving birth to the "umbonuloid" costae. This confirms the kenozooidal nature of the ovicell.

IV. HETEROZOOIDS

Seven out of nine species studied have avicularian or vibracularian heterozoooids. These are wanting in *M. antarctica* and *F. spatulata*. *C. innominata*, *C. paschalis* and *C. labiodentata* produce interzoecial avicularia. They are irregularly placed here and there and not connected with ovicells in both *Cribrilaria*. Those of *C. labiodentata* are budded distally by most of zooids and conceal ovicells in their quadrate chamber; most of their length accounts for the asymmetrical dentate rostrum containing a very large and acute mandibule. *Cribrilaria projecta* also has interzoecial avicularia issuing from triangular spaces between autozooids and near the peristome; they are small, triangular, columnar and proximally directed. The contention that avicularia are rare (Androsova, 1972: 336) is confirmed in the two colonies studied here, being present only in the older one.

The tiny columnar oral avicularia of *B. bellula* are not always present, being absent or spine-shaped in most of zooids of the studied colonies. They seem to be more common and larger in the samples studied by Osburn (1950) from the tropical American Pacific. The dependent avicularium of *P. magellanica* follows each zooid surmounting distally the aperture of unfertile ones or the ovicell in fertile ones. This avicularium, laterally directed and with a triangular mandibule, develops from an oval depression distal to the opesia and connected to the zoecial cavity through unipore septulae. Distally to it there is a triangular coelomic space which is also connected with the zoecial cavity through septulae. This space, which follows every avicularium, is covered by membrane and its significance is unknown. It was first observed by Calvet (1904b) who named it "Hoelung" and compared it with a somewhat similar structure in *Membraniporella agassizi* (Smitt). It can be considered as a terminal kenozooid. This kenozooid-like structure and the dependent associated avicularium make *P. magellanica* altogether different from other species in the genus *Figularia*, which typically have interzoecial avicularia with spathulated mandibules.

J. latimarginata stands apart from the other studied species and from all the other recent Cribriliniidae in that it develops vibracularian heterozoids and produces a fairly large amount of calcareous tissue filling the wide interzoecial furrows. Each of the vibracularia following an autozoid has a transversely oval to round chamber with an elongated transversal aperture having an impair proximally directed condyle for the articulation of the seta. The long setae measure up to one mm or more and are laterally directed. The spaces around the vibracularian chamber and the zoecial lateral walls are rapidly filled with calcareous deposits separating zoids as the species name indicates. These calcareous outgrowths seem to originate from the large dietellae of the lateral walls. In this character this species corresponds to many cretaceous forms in which these calcareous reinforcements are common (Lang, 1921; Larwood, 1969).

V. SYSTEMATIC POSITION

The generic position of *Cribrilaria innominata* and *C. paschalis* seems to be clear and sound (see Harmelin, 1970). *Jolietina latimarginata* on account of its very specialized vibracularian heterozoids deserves the separated generic position in which it has been placed. The same is valid for *Cribrilaria labiodentata* which clearly corresponds to the type-species of its genus, *C. curvirostris* Silén; it stands out, however, by the double row of pores between ribs. The presence of this species in Easter island completes the western north and south Pacific distribution of the genus *Cribrilaria* from near Japan (Silén, 1942) to New Zealand and Australia (Powell, 1967) to Easter island (Moyano, 1983). *Figularia spatulata*, although lacking interzoecial avicularia belongs, no doubt, to *Figularia* because of the structure of its ovicell and pericyst. This is not the case with the so-called *Figularia magellanica* (Calvet) (= *Membraniporella magellanica* Calvet, = *Cribrilina patagonica* Waters) in which the pericyst undergoes an extreme reduction as in some specimens of *F. fissa* (Harmer, 1926); in addition, interzoecial avicularia are altogether wanting and the ovicell is partially immersed in a distal dependent avicularium. All these characters make *Figularia magellanica* not congeneric with *Figularia*. It is neither possible to ascribe it to any other Recent genus nor to any fossil one on account of the following characters: (a) strongly reduced pericyst, (b) dependent distal avicularium, (c) hyperstomial ovicell being wrapped by the avicularium chamber and lacking the ectocystal windows of *Figularia* proper, (d) uniporous basal septulae, and, (e) each morpho-functional colonial module is made up of three elements: autozoid, avicularium and distal kenozooid. Hence, the necessity of introducing the new genus *Parafigularia* gen. n., already described above.

M. antarctica has the typical characteres of *Membraniporella*, that is, ribs free in most of their length fusing slightly in the centre of the pericyst and a hyperstomial ovicell. It lacks, however, the avicularia of the genotype *M. nitida* (Johnston). The umbonuloid structure of the frontal ribs in *Bellulopora bellula* justifies its inclusion in a different generic entity as proposed by Lagaaij (1963) and perhaps it would deserve a suprageneric status of its own. *Lyrula hyppocrepis*, as described and depicted by Osburn (1950, pl. 27, figs. 7, 8), seems to have the same costal

structure due to the presence of a large pore at the base of each rib, but this species shows instead very large interzoecial avicularia unlike *B. bellula*.

Cribrilina projecta from Antarctica seems to be not congeneric with *Cribrilina*. Its tiny avicularium is budded between zooids not replacing one of them in a series. Hasting (1964) suggested that it is also not congeneric with *Reginella*. Its peristome and the way in which it forms would indicate a separated generic status for this species, but the paucity of the available material and the imperfect knowledge of many Recent Cribriliniid genera do not permit us to formally propose it.

CONCLUSION

This study further shows that:

a. Chilean Cribrimorpha include the species: *Bellulopora bellula* (Osburn, 1950), *Cribralaria labiodentata* Moyano, 1983, *Cribrilaria innominata* (Couch, 1844), *Cribrilaria paschalis* Moyano, 1973, *Cribrilina projecta* Waters, 1904, *Figularia spatulata* (Calvet, 1909), *Jolietina latimarginata* (Busk, 1884), *Membraniporella antarctica* Kluge, 1914 and *Parafigularia magellanica* (Calvet, 1904).

b. *B. bellula* has umbonuloid costae issuing from dietellae and hence it is structurally different from most of the Recent Cribrimorpha.

c. Ovicell of *B. bellula* is immersed in a kenozooid structurally similar to an autozoid.

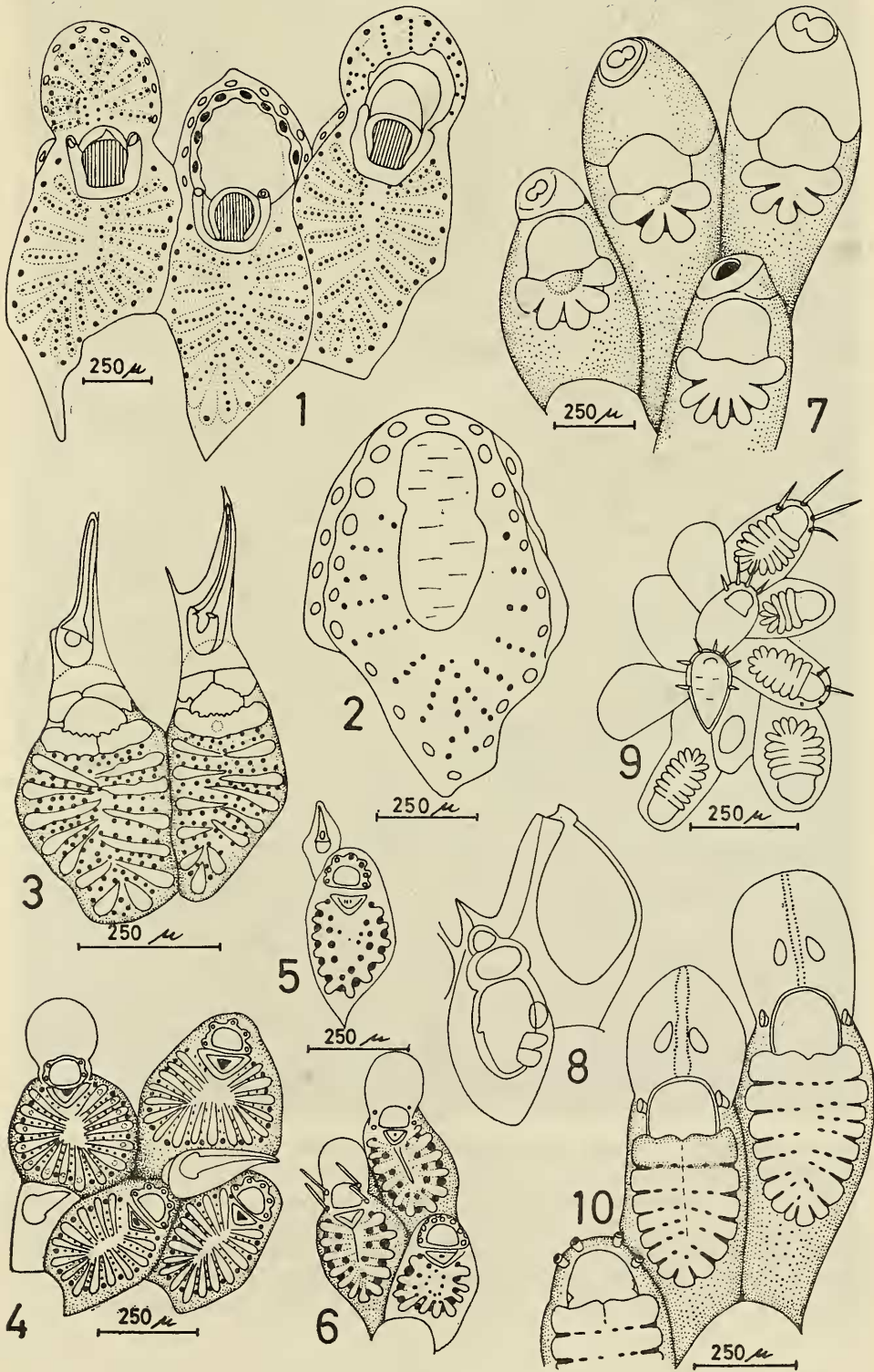
d. *C. labiodentata* from Easter island extends to the Eastern Pacific the geographical distribution of *Cribralaria*.

e. *C. projecta* develops a peristome giving the zooids an urceolate aspect, principally from two enlarged and multiramified oral spines. This character makes this species different from all Recent Cribrimorpha.

f. The new genus *Parafigularia* is proposed to include *Membraniporella magellanica* Calvet hitherto considered to be congeneric with *Figularia*.

g. *P. magellanica* colonies are made up of trilocular modules composed of an autozoid, a dependent transversal avicularium and a distalmost kenozooid. These characters indicate that this species is not congeneric with *Figularia*.

Fig. 1.- *Bellulopora bellula*. Three ovicelled zooids; the one right showing the small entoecium; that at centre exhibits an early stage of the ovicell ontogeny, black are costal dietellae and white dots intercommunication dietellae. Fig. 2.- *B. bellula*. Zooid at the colonial growing edge; developing pericyst forms as an umbonuloid fold. Fig. 3.- *Cribralaria labiodentata*. Two ovicelled zooids and interzoecial avicularia. Fig. 4.- *Cribrilaria innominata*. Fertile and unfertile zooids and interzoecial avicularia. Fig. 5.- *C. paschalis*. Infertile zooid and interzoecial avicularia. Fig. 6.- *C. paschalis*. Fertile zooids. Fig. 7.- *Parafigularia magellanica*. Note dimorphic apertures and distal avicularium. Fig. 8.- *P. magellanica*. Two zooids at colonial growing edge. At left the trilocular structure of each zoarial module. Fig. 9.- *Figularia spatulata*. Early astogeny. Note tatiform ancestrula. Fig. 10.- *F. spatulata*. Old ovicelled zooids.



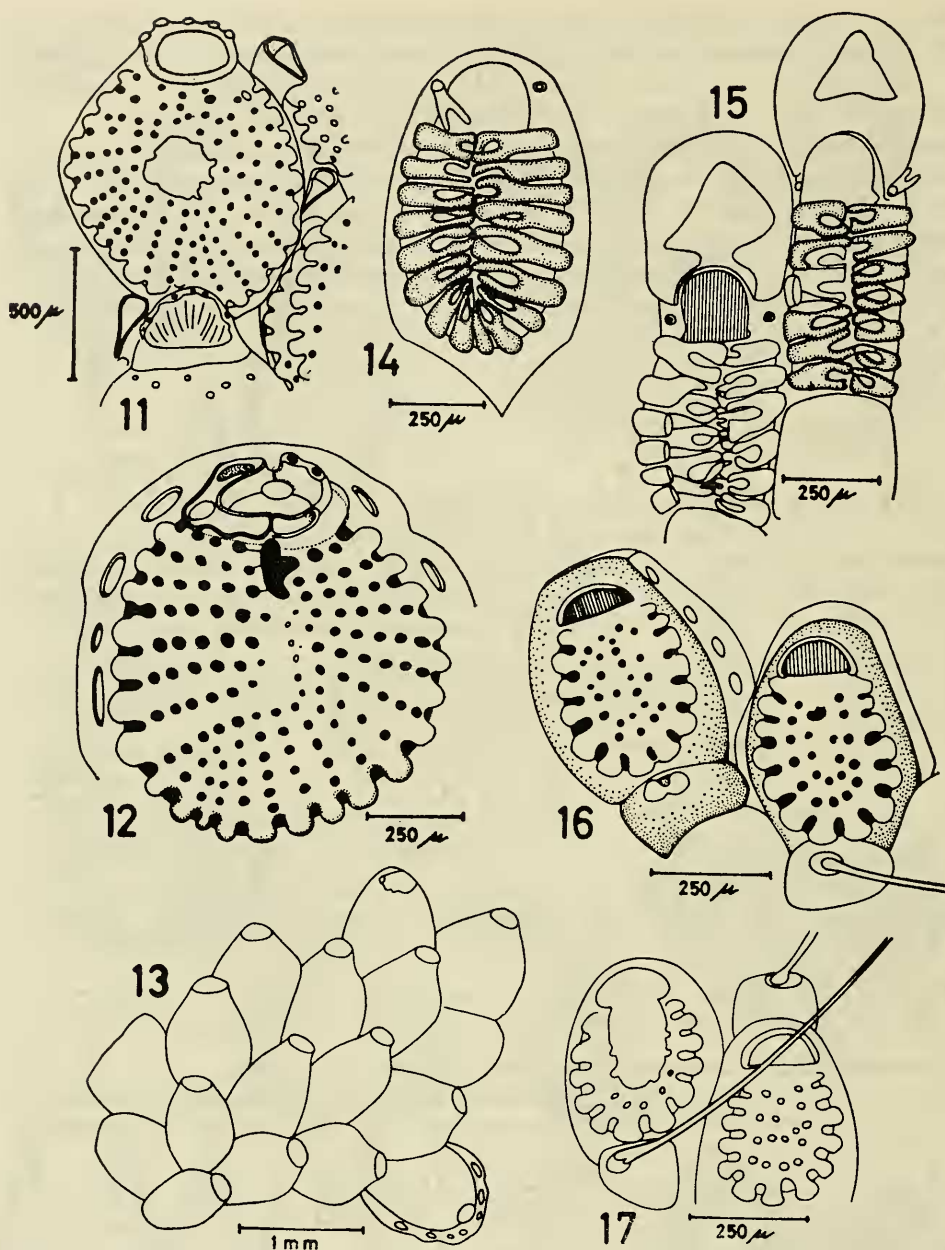


Fig. 11.- *Cribrilina projecta*. One zooid having a broken pericystal centre and three interzoecial avicularia. Fig. 12.- *C. projecta*. Young zooid at the growing edge showing an early stage in peristome development. Fig. 13.- *C. projecta*. Young zoarium having what seems to be the ancestrula. Fig. 14.- *Membraniporella antarctica*. Young zoecium having forked ribs. Fig. 15.- *M. antarctica*. Ovicelled zooids showing the triangular ectoecial fenestra. Fig. 16.- *Jolietina latimarginata*. Frontal view of zooids and vibracularia. Fig. 17.- *J. latimarginata*. Two young zooids at the colonial growing edge.

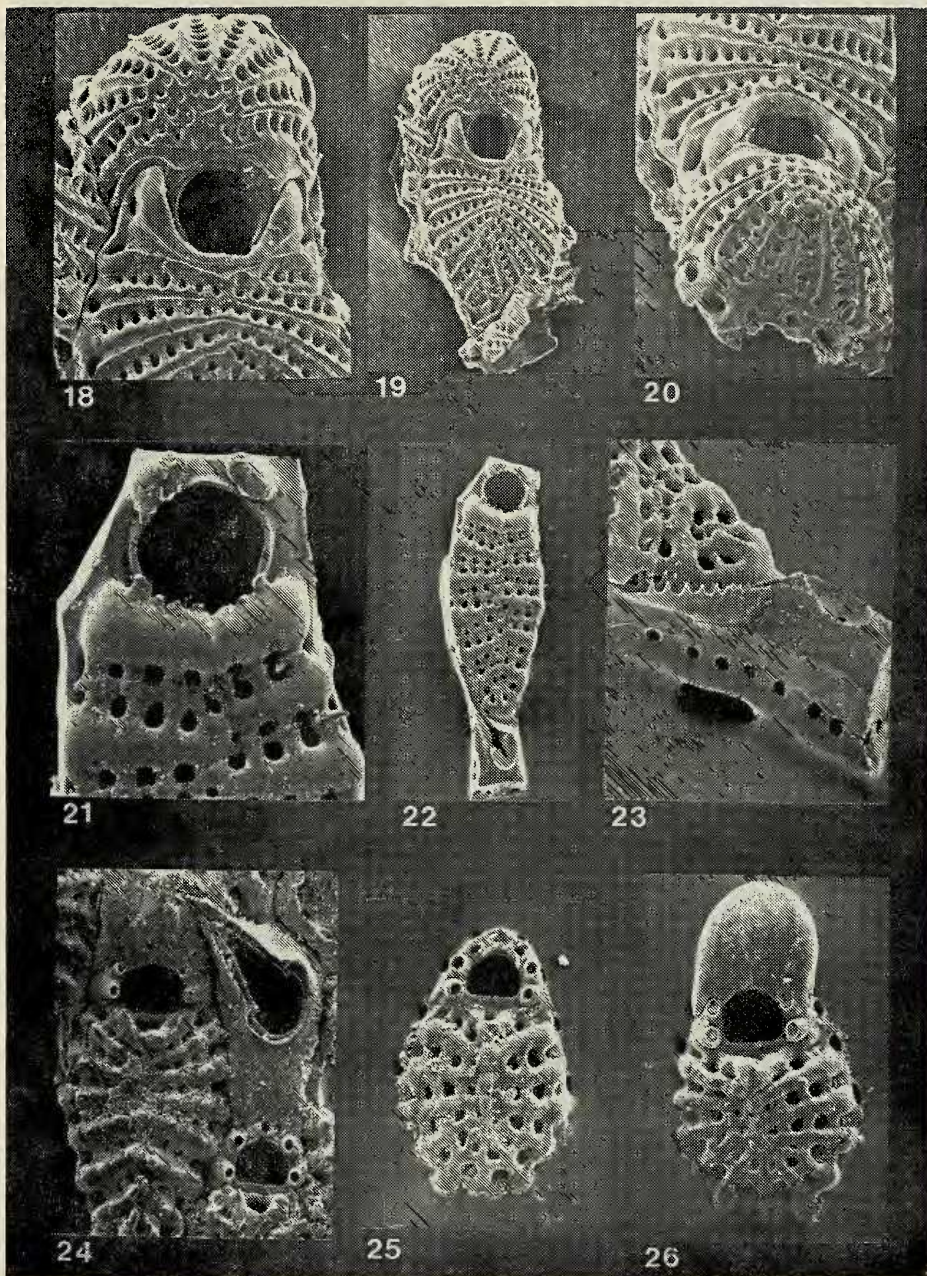


Fig. 18.- *Bellulopora bellula*. Oral area and ovicell. Fig. 19.- *B. bellula*. Frontal view of a complete ovicelled zooid. Fig. 20.- *B. bellula*. Rear view of ovicell showing the same structure as the frontal wall. Fig. 21.- *Cribralaria labiodentata*. Oral area and apertural bar made up of two stouter ribs. Fig. 22.- *C. labiodentata*. Interzoecial asymmetrical avicularium and unfertile zooid. Fig. 23.- *C. labiodentata*. Avicularium showing the serrate rostrum and the lateral septulae. Fig. 24.- *Cribrilaria innominata*. Frontal view. Note interzoecial avicularia suboral pore and number of apertural spine bases. Fig. 25.- *Cribrilaria paschalis*. Frontal view of an unfertile zooid. See the seven spine bases around aperture. Fig. 26.- *C. paschalis*. Frontal view of an ovicelled specimen.

(Figs. 18,20 x 74; 19 x 35; 21 x 115; 22 x 47; 23 x 97; 24 x 87; 25,26 x 103).

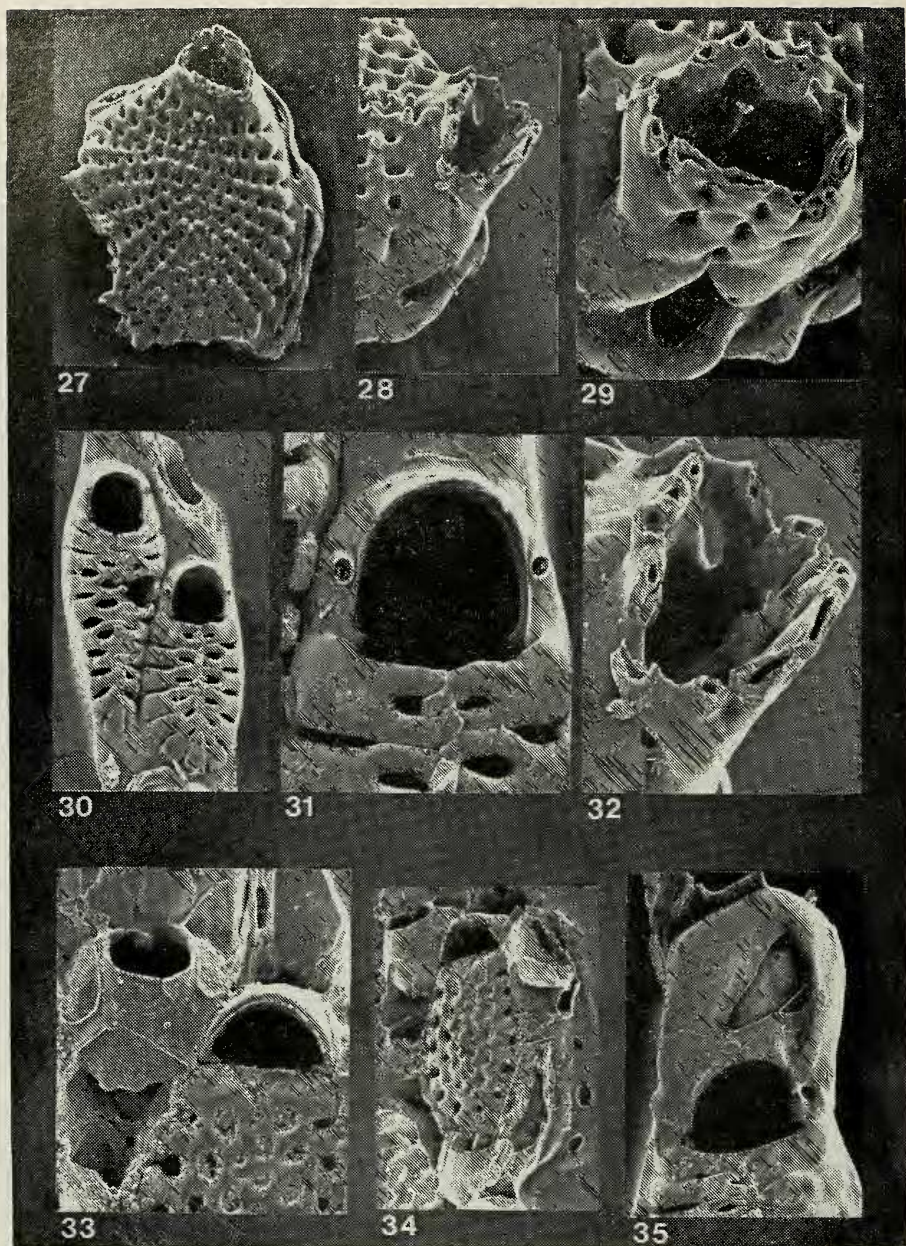


Fig. 27.- *Cribrilina projecta*. Frontal view of a young zooid. Round pores on frontal ribs (pelmatidia) are actually broken frontal spinules. Fig. 28.- *C. projecta*. Oral area in lateral view. See the apertural bar and the disto-lateral ramifying spines. Fig. 29.- *C. projecta*. Rear and upper view of latero-distal ramifying oral spines. Fig. 30.- *Membraniporella antarctica*. Frontal view. Fig. 31.- *M. antarctica*. Oral area and apertural bar. Note forked ribs. Fig. 32.- *C. projecta*. Lateral and upper view of the peristome. Note that the disto-lateral spines embrace upright growing processes of the apertural bar. Growing and fusion of these structures build up the peristome. Fig. 33.- *Jolietina latimarginata*. Oral area and vibracularian chamber. Note the condile inside the latter. Fig. 34.- *J. latimarginata*. Fronto-lateral view of a zoecium and the inter-zoecial "spaces" becoming later calcified. Fig. 35.- *M. antarctica*. Ovicell showing triangular ectoecial window.

(Figs. 27 x 42; 28 x 64; 29 x 117; 30 x 43; 31 x 143; 32 x 158; 33 x 113; 34,35 x 69).

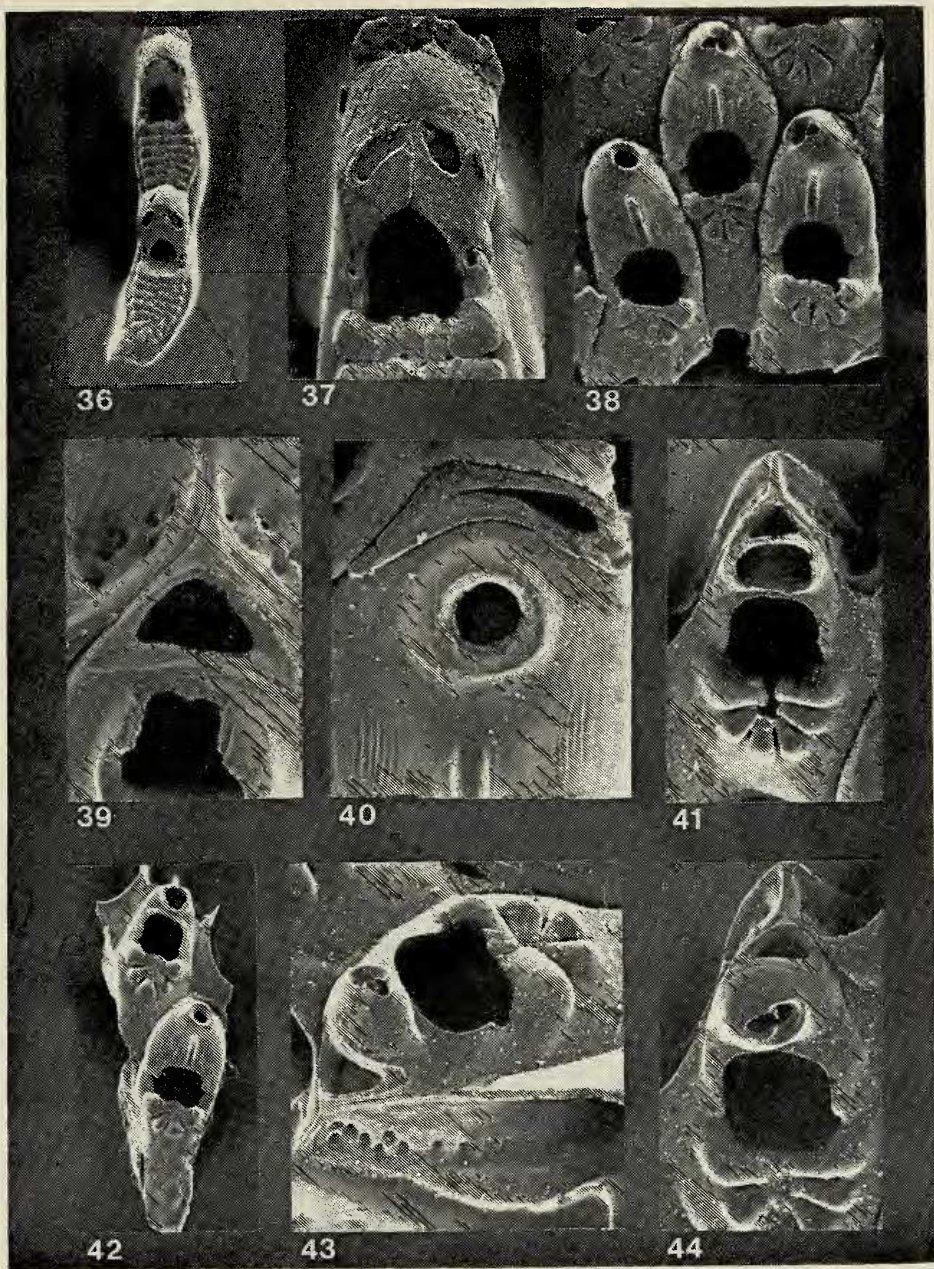


Fig. 36.- *Figularia spatulata*. Frontal view ovicelled zooids. Fig. 37.- *F. spatulata*. Ovicell exhibiting ectoecial windows. Fig. 38.- *Parafigularia magellanica*. Frontal view of three fertile zooids. The ovicell at left has an undeveloped avicularium on its distal part. Fig. 39.- *P. magellanica*. Distalmost kenozooid of an unfertile zooid. Fig. 40.- *P. magellanica*. Undeveloped avicularium crowning an ovicell and the distalmost kenozooid that has been compressed by the developing ovicell. Fig. 41.- *P. magellanica*. Developing zooid in frontal view showing the distalmost complex of avicularium plus kenozooid. Fig. 42.- *P. magellanica*. Young zooids at the colonial growing edge. Fig. 43.- *P. magellanica*. Lateral view of zoarial module showing autozooid, avicularium and kenozooid. Note on lateral wall uniporous septulae. Fig. 44.- *P. magellanica*. Frontal view of a more advanced stage than that on fig. 41. (Figs. 36 x 27; 37 x 72; 38 x 45; 39 x 111; 40 x 148; 41 x 70; 42 x 31; 43 x 80; 44 x 81).

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